

**A Work Project, presented as part of the requirements for the Award of a Masters  
Degree in Finance from the NOVA School of Business and Economics.**



# **Bank Capital and Stock Performance around the Subprime Lending Crisis**

## **Work Project**

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**A Project carried out on the Masters in Finance, under the supervision  
of Prof. Miguel Ferreira**

**June 2013**

# **BANK CAPITAL AND BANK STOCK PERFORMANCE AROUND FINANCIAL SUBPRIME CRISIS**

## **ABSTRACT**

This empirical study observes the relationship between bank capital and stock performance when an unexpected negative shock materializes to bank value. The analysis covers the three months after the collapse of Lehman Brothers on the 15<sup>th</sup> September 2008, using the holding period stock return as the dependent variable. With data from the US largest commercial banking and saving and loans institutions, we constructed a multiple regression model and performed several estimations using different definitions of bank capital. Our conclusions are consistent with the premise that better capitalized banks are in a better position to withstand the negative impacts of a disruptive financial event, such as the Lehman collapse, and therefore are susceptible to smaller stock price declines. We also find evidence that simpler and more conservative capital ratios are perceived by equity market participants as more accurate measures of bank health relative to regulatory risk based ratios. Therefore, our results provide support to the inclusion of simpler capital ratios that rely on balance sheet information to bank regulatory frameworks.

Keywords: Bank capital, subprime lending crisis, moral hazard.

## INTRODUCTION

Extensive literature addressing the implications of capital requirements in banks' risk-taking incentives and performance usually perceives capital requirements as an effective tool to restrain moral hazard created by deposit insurance<sup>1</sup>, due to the complexity of computing a risk-weighted insurance premium (Chan, Greenbaum and Thakor, 1992). The premise is that forcing banks to fund their assets with a larger equity stake should restrain their incentives for excessive risk-taking (see for instance Keeley and Furlong, 1989; Furlong and Keeley, 1990)<sup>2</sup> and reduce their vulnerability to market disruptions by increasing their capacity to absorb unexpected losses with their own resources. In the context of the huge losses incurred by banks during the US subprime lending crisis, our paper tries to make a contribution in understanding this relation. We search for evidence that better capitalized banks are in a superior position to withstand unanticipated blows to bank value that materialize during a financial crisis, such as the subprime lending crisis, by observing the relationship between pre-crisis capital levels and the stock performance during a crisis period.

One additional issue that we investigate is the quality of capital held by banks. The “procyclicality” of the Basel II risk-weighted, where fluctuations are amplified by business cycles<sup>3</sup>, means Tier 1 and Tier 2 capital may be heavily deteriorated during a crisis period and, therefore, we are interested in understanding whether equity markets better judged simpler and more conservative ratios that focus on balance sheet information, as common equity is the component of capital available to absorb bank losses.

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<sup>1</sup> See Merton (1977).

<sup>2</sup> See also Santos (1999) and Rochet (1992)

<sup>3</sup> See for instance Kee Young Park, 2012.

Our analysis focus on stock returns from the largest listed US commercial banks and savings and loans institutions during the three months following the Lehman Brothers Holdings Inc. collapse on the 15<sup>th</sup> September 2008. We investigate the relationship between different measures of bank capital and stock performance in the cross section to understand whether bank capital levels prior to the shock had any influence in banks stock performance after the shock. We control for a series of bank specific variables that account for bank business model, sources of fund, liquidity, asset quality, size and standard asset pricing factors.

Our baseline model is inspired by the empirical study of Kunt, Detragiache and Merrouche (2010) in estimating the relationship between bank capital levels and stock performance in the cross section. We investigate this relation for the full sample and for three subsamples separated by bank size. Our measures of bank capital include risk-weighted ratios – Basel Capital Adequacy Ratio, Tier 1 Ratio and Tier 2 Ratio – and balance sheet ratios – Tangible Common Equity Ratio, Leverage Ratio and, as suggested by Estrella, Park and Peristiani (2000), one bank capital measure that accounts for both on and off-balance sheet activities. We find evidence for our full sample to support that better capitalized banks suffered a smaller deterioration of their stock price during the period but only balance sheet ratios were significant in explaining stock performance. To account for the discrepancies between banks with different size, we define total assets thresholds similar to the ones used in the empirical work of Berger and Bowman (2009) and also conduct our analysis for three separate subsamples according to banks' total assets. Across the large banks subsample, our conclusions report that banks with higher risk-weighted ratios are in a better position to absorb the unexpected shocks from a financial disruptive event but still balance sheet ratios are, in

general, perceived by equity markets as a better measure of resilience and financial health. Finally, we find no significant relationship between bank capital and stock performance during the sample period across the mid and small banks subsample. The rest of the paper is structured as follows: section two provides a brief literature review; section three provides a description on the data and methodologies used; section four discusses the empirical results; section five delivers a conclusive statement.

## **LITERATURE REVIEW**

To formulate our hypotheses, we delve on theoretical literature related to deposit insurance and the roles of bank capital regulation.

Deposit insurance schemes are offered by governments to insure depositors and insulate banks from runs (Diamond and Dybvig, 1983). However, by modelling deposit insurance as a put option on the value of the bank's assets with an exercise price equal to the promised maturity of its debt commitments, Merton (1977) showed that banks seeking to maximize the value of their equity will maximize the value of the put by either shifting to riskier investments or by increasing leverage, creating a moral hazard issue. Due to the impossibility of determining risk-sensitive insurance premium and thus charge banks a fair premium for their granted protection (Chan, Greenbaum and Thakor, 1992), capital regulation is viewed as one of the most crucial tools in dealing with moral hazard. Furlong and Keeley (1989) and Keeley and Furlong (1990) showed that publicly listed banks seeking to maximize their equity value will reduce the risk profile of their investments as a result of higher bank capital requirements because lower leverage levels are associated with a lower marginal value of the deposit insurance put option with respect to asset risk, assuming a fixed rate insurance

premium. Additionally, Santos (1999) addressed the principal-agent problem between banks and borrowing firms and claimed that, due to limited liability, banks have an incentive to change their contracts' lending terms to induce borrowers to take on more risk, a problem that can be solved by increasing the bankruptcy costs of a bank through higher capital requirements. Still, these previous theories are challenged by a different set of literature that claims there is room for a positive relationship between capital standards and risk. Koehn and Santomero (1980) modelled banks as portfolio managers who maximize their risk-return combination in the efficiency frontier, in which case introducing a flat capital requirement might create a situation in which the bank reconfigures its investments to riskier assets to offset the loss of expected return by being forced to operate with lower leverage. Kim and Santomero (1988) showed that this issue may be addressed by capital requirements that are risk-based. In addition, Calem and Rob (1999) used a dynamic model to prove that the relationship between higher capital requirements and risk taking changes with the level of bank capitalization – low capitalized and highly capitalized banks increase risk to take advantage of deposit insurance and low probability of insolvency, respectively, as a result of an increase in capital requirements.

These two opposing views provide sufficient motivation for empirical research to be conducted regarding the relationship between stock performance and bank capital. Kunt, Detragiache and Merrouche (2010) explore whether higher bank capital levels was associated with better stock performance during the US recent financial crisis (Q3. 2007 – Q1. 2009). The authors use a multi-country panel of banks and provide evidence that, during the crisis, better capitalized banks experienced smaller decline in their equity value, particularly for larger banks. The authors also conclude that stock returns

were more sensitive to a leverage ratio (Tier 1 to total assets) rather than to risk-weighted ratios. Similarly, Berger and Bowman (2009) look into the relationship between bank capital and bank performance around normal and crisis periods and found a meaningful positive relationship between bank capital and stock performance during crisis periods only for the credit crunch of the early nineties (Q1. 1990 – Q4. 1992) but not for the subprime lending crisis. Still, the authors do not distinguish between different measures of bank capital. Our research is also motivated by one last empirical project. Estrella, Park and Peristiani (2000) explore how bank capital level fared in predicting bank failures, covering US bank failures from 1989 to 1993. According to the authors, a good measure of capital adequacy should be very closely related to bank failure and, therefore, they observe and compare the informative power of different measures of bank capital about subsequent failures. They look into banks' Tier I to total assets ratio (leverage ratio), Tier I risk-weighted capital ratio and Tier I to gross revenue ratio. The authors find evidence that, over longer term horizons, the risk weighted ratio is the most effective predictor of bank failure but, over one and two year horizons, the three capital measures have similar predictive power concerning bank failures. In line with their conclusions, the authors argue that, over short term horizons, the leverage ratio and gross revenue ratio can play an important role in bank regulation as they are simpler and virtually costless to calculate, while the regulatory burden carried in with risk weighted capital ratios is not offset by a higher explanatory power.

## **METHODOLOGY – BASELINE MODEL**

The methodology used to assess our main goal is a slightly altered approach of the procedure used by Kunt, Detragiache and Merrouche (2010) in establishing an empirical

relation between bank capital and bank stock performance. In particular, the core of this paper focuses solely on the three month holding period stock return of publicly listed US banking institutions after an unexpected shock to bank value materialized, such as the Lehman Brothers' failure, disregarding the need to account for country and time specific variables. Our focus is to determine whether better capitalized banks were able to better resist the unexpected losses that materialized with the collapse of Lehman Brothers by witnessing a smaller decline in their stock price than that of poorer capitalized banks. We perform several estimations using the regression model below.

$$s_i = \beta_0 + \beta_1 \text{Capital Level}_i + \sum_{j=2}^8 \beta_j \text{Control}_i + \mu_i \quad (1)$$

The model is estimated through robust least squares (RLS) to account for conditional heteroskedasticity inherent to equity prices (French, Schwert and Stambaugh, 1987) and explanatory variables are lagged nine months to ensure that information on each bank is incorporated in its stock price (Fama and French, 1992).

$s_i$  is the dependent variable and accounts for the three month holding period<sup>4</sup> stock return of each bank comprised in our sample following the Lehman Brothers' collapse. **Capital level<sub>i</sub>** stands for the pre-crisis bank capital and represents our key explanatory variable. In addressing the impact of pre shock bank capital levels on the after-shock stock returns, we want to understand which form of capital was more relevant to stock performance. For that purpose, we perform separate estimations of equation (1) for several different measures of bank capital in order to avoid collinearity problems between our key predictors. Our first measure of bank capital is the capital adequacy ratio as defined by the Basel II regulatory framework<sup>5</sup>. We also examine each

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<sup>4</sup> From 16/09/2008 to 16/12/2008

<sup>5</sup> See "The new Basel Capital Accord: An explanatory Note", Bank for International Settlements, 2001.



constituent of the latter ratio separately – Tier I ratio (composed of common and preferred stock and disclosed reserves) and Tier II ratio (lower quality capital mostly composed of subordinated debt) – to account for the quality of its capital instruments. In addition, we include more conservative approaches to bank capital measured by the tangible common equity (TCE) ratio, which is obtained by dividing each bank's tangible common equity by its tangible assets<sup>6</sup>, and by the leverage ratio, obtainable by dividing tier 1 capital by total assets. Our goal is to understand whether equity markets incorporate in their expectations the “procyclicality” of risk-weighted ratios (Ki Young Park, 2012) and perceive better quality capital as a more accurate measure of bank health and resilience, as tier 1 capital and, in particular, common equity, are the components of capital available for banks to absorb unexpected losses. Finally, we include a proxy for the gross revenue ratio used by Estrella, Park and Peristiani (2000) in predicting bank failures, which we will from now on refer to as E Ratio. The authors obtain their ratio by dividing Tier 1 by gross revenue. Our departure from the literature consists on dividing Tier I capital by total balance and off balance sheet assets instead. We want to account for the increasing tendency of banks engagement in off-balance sheet activities as part of the financial innovation and securitization hype and so, consistent with the authors view, we consider this ratio to be a better risk assessment of a bank's uses of funds. In line with this view, we want to observe how equity market participants perceive this capital measure.

To isolate the explanatory power of bank capital in our cross sectional analysis we include in our model a set of bank specific explanatory variables. The variable **Control<sub>i</sub>** in equation (1) stands for such bank specific variables that account for bank

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<sup>6</sup> Tangible common equity was obtained by subtracting intangible assets and preferred equity from common equity and tangible assets was obtained by subtracting intangible assets from total assets.

business model, sources of funding, asset quality, liquidity, size, profitability, value and correlation with the market. A more detailed section explaining these variables is provided further on this section. We test for the following hypotheses.

**Hypothesis 1:** Controlling for bank specific variables, it is expected that the stock price of better capitalized banks does not fall as much as that of poorly capitalized banks.

**Hypothesis 2:** Controlling for bank specific variables, it is expected that simpler and more conservative capital ratios that rely on balance sheet information have a higher positive impact on stock performance than regulatory risk-weighted capital ratios.

Over the course of our regressions we also grouped our sample into three different categories according to bank size measured by total assets. In doing so, our aim is to alleviate the bank size bias as moral hazard tends to play differently amongst different sized banks. More information regarding this approach is provided in the paragraph below. We followed a division similar to the one performed by Berger and Bowman (2009) and defined large banks with assets exceeding US\$ 4 billion, medium banks with assets exceeding US\$ 1.5 billion and up to US\$ 4 billion and small banks with assets up to US\$ 1.5 billion.

As previously mentioned, we controlled for bank specific variables that were considered to be relevant in assessing bank stock performance during our analysis period. Controlling for size, we accounted for each bank's total assets<sup>7</sup>. We relied on some existing theory on banking that suggests banks' diversification and size to be positively correlated (Diamond, 1984) and that points out to the fact that larger banks

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<sup>7</sup> Variable included in regression model as log (total assets)

have historically used their diversification benefits to operate with higher leverage levels (Liang and Rhoades, 1991) and invest in riskier assets (Demsetz and Strahan, *Journal of Money, Credit and Banking*, 1997)<sup>8</sup>. We expect that larger banks are better able to take advantage of “regulatory arbitrage” opportunities, enabling them to find ways to hide risk and give their balance sheet the appearance of stability – for instance, through securitizations – in which case they are more vulnerable to unexpected negative shocks (Kunt, Detragiache and Merrouche, 2010). Controlling for banks’ business models, we looked into banks total loans (net of unearned income) to total assets ratio. We find this an accurate approach to capture the extent of bank exposure to credit risk and potential liquidity shortages and thus expect a negative impact by this ratio on the stock performance of banks. As a complement, we also look into the quality of banks’ loan portfolios by including in our model the provisions set aside by banks to cover loan losses as a percentage of total assets. According to Thakor (1987), a change in the provision for loan losses might be a reflection on the future health of a bank’s loan portfolio. Also Madura and Zarruk (1992) observed that an increase in banks’ provisions for loan losses related to bad real estate loans is translated in negative stock performance. Hence, we expect a negative relationship between bank stock performance and this variable. Controlling for banks’ sources of funds, we assessed their reliance on deposit funding, by dividing each bank’s total deposits by total assets. Due to the disruption in the wholesale funding market during the crisis, we consider that banks funded with a higher portion of deposits were perceived to be in a more stable position, which would be reflected by a better stock performance. In addition, we controlled for liquidity by including a ratio that divided total cash due from banks by total assets. Cash

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<sup>8</sup> See also Stiroh (2004), Demirgüç-Kunt and Huizinga (2010), Berger and Mester (1997), who argue that larger banks tend to engage in riskier investments and depend less on deposit funding and more on wholesale funding due to their lower funding costs

due from banks includes cash on hand, cash items in the process of collection and non-interest deposits with banks. A higher ratio suggests that a bank is in a better position to manage unexpected cash needs and so we expect a positive relationship with stock performance. Finally, we included in our set of control variables the price to book ratio, return on equity and correlation with the market, in order to account for the factors used in standard asset pricing models (Fama and French, 1992, *The Journal of Finance*).

## **DATA**

In order to construct explanatory variables at the individual bank level for our baseline model, we combine accounting data from COMPUSTAT with data from Bloomberg. Our sample includes all US listed commercial banks and savings and loans institutions (federally and non-federally chartered), with Standard Industrial Classification (SIC) 6020, 6035 and 6036, respectively. The following bank capital variables and control variables, with their respective COMPUSTAT codes, are obtained for December 2007: total assets (AT), risk adjusted tier 1 capital ratio (CAPR1), risk adjusted tier 2 capital ratio (CAPR2), risk adjusted capital ratio (CAPR3), cash and due from banks (CDBT), common equity (CEQ), tangible common equity (CEQT), total deposits (DPTC), goodwill (GDWL), intangible assets (INTAN), total investment securities (IST), loans net of unearned income (LG), non-redeemable preferred stock (PSTKN) and preferred stock liquidation value (PSTKL).

We use Bloomberg to obtain stock prices for the banks in our sample and to fill in missing balance sheet information unavailable in COMPUSTAT, namely price-to-book ratios (PX\_TO\_BOOK\_RATIO), return on common equity (RETURN\_COM\_EQY) and market betas (APPLIED\_BETA). Regarding the baseline model, we obtain stock

prices for the 16<sup>th</sup> of September 2008 and for the 16<sup>th</sup> of December 2008 and compute the holding period return. Our sample is comprised of 320 US listed commercial banks and savings and loans institutions, separated into 98 large banks, 104 medium banks and 118 small banks.

### *Summary Statistics*

Table A provides a descriptive analysis for the sample period of the variables included in our baseline model. Regarding bank capital levels, the median for the full sample capital adequacy ratio is 11.65%, which is in compliance with the minimum capital requirement of 10% recommended by the Basell II guidelines. The ratio remains relatively stable when we divide the full sample according to bank size. For the full sample Tier I and Tier II capital ratios, their respective medians stand at 10.00% and 1.26%. The subsample of larger banks seems to rely less on Tier I capital (9.32%) and more on lower quality instruments of capital (Tier II of 2.43%) relative to the mid (Tier I – 9.96%; Tier II – 1.25%) and small subsamples (Tier I – 10.44%; Tier II – 1.20%).

The full sample median for the TCE ratio is 7.03% and the leverage ratio is 9.20%. Larger banks have a slightly higher median for the leverage ratio (9.53%) and lower median for the TCE ratio (6.14%). Finally, the full sample median for the E ratio is 7.92% and is somewhat similar across all subsamples (7.87%, 7.92% and 8.00% for the large, mid and small subsamples, respectively). In conclusion, there is some evidence to support that larger banks operate with higher leverage levels<sup>9</sup> and lower quality of capital. Their median holding period return holding period stock return (HPR) is approximately minus 24.57%, while the median for the mid and small subsample is

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<sup>9</sup> See Liang and Rhoades, 1991 and Demsetz and Strahan, Journal of Money, Credit and Banking, 1997

minus 20.69% and minus 23.39%. For the full sample, the median holding period stock return is -23.29%.

In terms of our bank specific control variables, we observe that small banks are less exposed to market fluctuations, as measured by their market beta (0.51), which might suggest that small banks were less exposed to economy-wide systemic risk and better buffered to navigate through the financial crisis. Regarding banks' sources of funds, banks within the large group tend to rely less on deposit funding (0.68) than banks within the mid and small group. In terms of banks' business models, we observe that banks within the large group have a lower proportion of loans on their overall asset base. Finally, we also observe that banks within the large group set aside larger provisions for loan losses as a percentage of total assets, which might indicate that larger banks engaged in riskier activities in the past.

## **BASELINE MODEL RESULTS**

The model uses bank capital, balance sheet information and standard asset pricing factors as explanatory variables, lagged nine months from the dependent variable, to predict the stock performance of listed US retail banking institutions for the three months following the Lehman Brothers' collapse on the 15<sup>th</sup> September 2008. We present estimation results across tables B.

Our results regarding the relationship between bank capital and stock performance are consistent with the empirical conclusions of Kunt, Merrouche and Detragiache (2010) and confirm our first hypothesis that higher capitalized banks suffer lower declines on their stock price after an unexpected disruptive event takes place. In addition, we found supporting evidence to the results of Estrella, Park and Peristiani

(2000) in the sense that the regulatory burden of risk weighted capital ratios does not translate into higher power in explaining bank performance over short term horizons.

For the full sample, the risk weighted capital ratios, as defined by Basel regulatory framework, are positive but not significant, even after splitting capital into Tier 1 and Tier 2. The latter result changes for the subset comprising large banks. The capital adequacy ratio is positive and significant at the 5% level, rewarding stock performance during the crisis period with a stock return increase of 133 basis points per each additional percentage point increase in the pre-crisis ratio. Splitting between Tier I and Tier II, the ratios remain (marginally) significant but with opposing signs. This confirms that when assessing the capital adequacy ratio, investors are more focused on higher quality capital instruments, which is reflected by the Tier 1 positive coefficient (1.7). On the contrary, increasing the proportion of pre-crisis Tier 2 capital by one percentage point is expected to deteriorate stock performance during the crisis period by approximately 215 basis points. One possible explanation for such preference is that, since Tier II capital is mostly comprised of subordinated debt instruments, it is easier to cut dividends than to default on interest payments when additional cash is needed, providing equity instruments a higher mobility to deal with unexpected market fluctuations. The Basel capital ratios are not significant in the subsets comprising mid and small size banks.

Turning to the leverage ratio, our estimation for the full sample dictates that an increase in its pre-crisis level by one percentage point is translated into an increased stock return during a crisis period by 124 basis points. This result is significant for a 99% confidence level. On our subset of large banks, the leverage ratio remains significant at the 1% level and has an even higher magnitude, with stock return

estimated to increase by 186 basis points per each percentage point increase in the ratio. The leverage ratio is not significant in the subsets comprising mid and small size banks.

Regarding the tangible common equity ratio, our result for the full sample estimates stock return to increase roughly by 70 basis points during a crisis period with each additional percentage point increase in this pre-crisis ratio. This result is only marginally significant. Still, for the subset of large banks, the magnitude of the coefficient associated to the TCE ratio is higher (1,347) and significant at the 5% level. Finally, regarding the E ratio, we find that it had the highest, significant impact on stock performance during the crisis (1.345) for the full sample. This suggests that equity markets also placed high value on information regarding off-balance sheet activities, particularly because during the years that preceded the bust financial firms oversaw the securitization of real estate mortgages along with many types of consumers loans into asset backed securities, many of which were “bad loans”. This ratio remains significant at 5% for the subset comprising the large banks and is still a strong predictor of stock performance during the crisis (1.347). Both the leverage ratio and the gross revenue ratio are not significant across the mid and small subsets of banks.<sup>10</sup>

Turning to bank controls, our results seem consistent with our initial expectations. Our full sample results show that banks with a higher proportion of their funds invested in loans were worse perceived by equity markets, which is a clear reflection of the increasing exposure of banks’ loan portfolios to subprime borrowers over the years that preceded the financial crisis. In this sense, the Lehman Brothers’ collapse was an important catalyst of the crisis as it enhanced the lack of confidence in banks’ portfolios and enhanced the problem of asymmetry of information between banks and

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<sup>10</sup> Kunt, Detragiache and Merrouche (2010) provide an explanation based on the Caleb-Rob model for the reason capital only affects stock returns among large banks.



investors/borrowers. Interestingly, these results hold but are only significant for the subsets of mid and small size banks, which might reflect the bailout expectations held by investors for large banks but not so much for mid and small ones. We also find evidence regarding this issue by observing that, for the full sample, banks with higher provisions set aside as allowances for “bad loans” suffered a higher negative impact on their stock price during the months following the Lehman Brothers’ collapse. Again, this result holds but is significant only for the mid and small subsets of banks. Our discussion regarding banks’ business model and asset quality is consistent with Cavallo and Majnoni (2002), who found that banks with higher loan to asset ratios are usually more exposed to credit risk and thus their provisions for loan losses are higher.

Bank size was also captured by equity markets as an important sign of financial health. Our full sample estimation suggests that investors perceived larger banks to be more prone to the subprime and securitization machine and, therefore, much more exposed to credit risk. As securitization became commonplace during the years that preceded the crisis, banks shifted to aggressive growth policies that involved credit expansion at the expense of pervasive managerial practices, which might provide an explanation to the negative coefficient associated with the size control variable.

In terms of liquidity, our cash position indicator seems to be quite a significant predictor of bank performance but only for the mid and small subsets, with its predicting power much stronger in the mid group.

Finally, the only variable viewed positively by investors relates to bank profitability, with bank return on equity having a positive and significant coefficient sign for the full sample. This result is significant at 1% level and only holds significant for the subset of large banks.

The coefficients of the control variables previously discussed have minimal variations across each regression for different measures of bank capital and their significance remains unchanged. All of the remaining lagged control variables were not significant in explaining bank stock performance during the crisis period.

## **CONCLUSION**

Our empirical analysis provides some insight to the relationship between bank capital requirements and equity value. We investigate the 320 largest US listed retail banking institutions and study the impact of bank capital on each bank's stock performance during the three months that followed the Lehman Brothers' collapse. The goals of our study are to understand whether higher bank capital provided banks with a superior capacity to withstand the unexpected shock that materialized to bank value and, if so, whether better quality capital instruments were better perceived by equity markets.

Our results are strongly consistent with the empirical study of Kunt, Detragiache and Merrouche (2010) and support the hypothesis that better capitalized banks are in a superior position to withstand the negative shocks that materialize to bank value during financial crisis. We find that risk-weighted capital ratios were only significant predictors of stock performance for large banks but did not outperform cruder bank capital measures, as stock returns were more sensitive to the TCE ratio, the leverage ratio and the E ratio. We find that capital ratios do not help explaining stock returns for the small and mid-size sample of banks.

In terms of policy implications, our results support the argument put forth by Estrella, Park and Peristiani (2000) that risk-weighted capital ratios do not outperform cruder balance sheet capital ratios in explaining stock price variations over short term

horizons. We also provide evidence related to how negatively equity markets perceived low quality capital (Tier 2) as defined by the Basel framework, which suggests the need for the revision of the type of instruments eligible for regulatory capital to include simpler ratios that are easier to implement and to increase the quality of capital that is used to absorb unexpected losses. This paper provides some motivation for future research regarding this theme, for instance, by applying a similar empirical analysis on banks that operate within different regions of the world to infer whether the Basel framework works similarly across the globe.

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## APPENDIX

*Table A: Descriptive Statistics*

Table A provides a statistical description of the variables used in the regression analysis. Information regarding capital ratios and balance sheet variables is obtained from the COMPUSTAT database for December 2007, while information regarding market based variables (P/B ratio, Beta and RoE) is obtained from Bloomberg for December 2007. Information regarding stock prices is obtained from Bloomberg for the 16<sup>th</sup> September 2008 and 16<sup>th</sup> December 2008 and the holding period stock return is obtained for each bank. We use the median over the mean, as the latter is not a robust measure of the central tendency due to the existence of very outliers.

Sample	Full	Large	Mid	Small
# Observations	320	98	104	118
Holding period return	-23.29%	-24.57%	-20.69%	-23.39%
Capital Adequacy Ratio	11.65%	11.70%	11.51%	11.87%
Tier 1 Ratio	10.00%	9.32%	9.96%	10.44%
Tier 2 Ratio	1.26%	2.43%	1.25%	1.20%
Leverage Ratio	9.20%	9.53%	9.02%	9.07%
E Ratio	7.92%	7.87%	7.92%	8.00%
Tangible Equity Ratio	7.03%	6.14%	6.80%	7.97%
Loans to assets	0.73	0.68	0.76	0.76
Deposits to assets	0.73	0.68	0.75	0.75
LLP to assets	0.00	0.00	0.00	0.00
Cash position indicator	0.02	0.02	0.02	0.02
Total assets (US millions)	2197	11097	2407	1008
Market beta	0.95	1.06	1.07	0.51
Return on equity (%)	10.14	11.23	9.60	10.04
Price to book ratio	1.49	1.50	1.53	1.46

**Table B:** Baseline model – Regression results- Full Sample

Table B displays the baseline regression results for the entire sample. Results are obtained from robust least squares regressions. The dependent variable is the holding period return during the three months following the Lehman Brothers failure (from 16<sup>th</sup> September 2008 to the 16<sup>th</sup> December 2008). Six different estimations of the model are computed for each bank capital measure. The values in parenthesis represent the p-values. The sample is composed of 320 banks and the adjusted r-squared is presented on the bottom of the table.

FULL SAMPLE	CAR	Tier 1	Tier 2	Leverage	TCE	E Ratio
<b>Constant</b>	0.139 [0.4884]	0.133 [0.513]	0.265 [0.133]	0.107 [0.538]	0.153 [0.396]	0.204 [0.224]
<b>Bank Capital Ratio</b>	0.415 [0.231]	0.599 [0.223]	0.208 [0.693]	1.244 [0.001]	0.696 [0.079]	1.345 [0.001]
<b>Loans to assets</b>	-0.299 [0.011]	-0.286 [0.012]	-0.331 [0.003]	-0.342 [0.001]	-0.345 [0.001]	-0.42 [0.000]
<b>Deposits to assets</b>	-0.094 [0.5347]	-0.13 [0.383]	-0.119 [0.44]	-0.086 [0.56]	-0.077 [0.607]	-0.097 [0.507]
<b>LLP to assets</b>	-13.054 [0.000]	-12.961 [0.000]	-13.35 [0.000]	-11.268 [0.000]	-12.793 [0.000]	-11.421 [0.000]
<b>Cash to assets</b>	-0.167 [0.737]	-0.194 [0.697]	-0.126 [0.801]	-0.431 [0.382]	.0287 [0.563]	-0.517 [0.299]
<b>Log(size)</b>	-0.082 [0.001]	-0.075 [0.005]	-0.091 [0.000]	-0.089 [0.000]	-0.076 [0.003]	-0.095 [0.000]
<b>Market beta</b>	0.052 [0.1946]	0.043 [0.2861]	0.052 [0.197]	0.044 [0.261]	0.054 [0.173]	0.049 [0.214]
<b>Return on equity</b>	0.007 [0.004]	0.006 [0.0063]	0.007 [0.007]	0.008 [0.001]	0.007 [0.003]	0.008 [0.001]
<b>P/B Ratio</b>	0.034 [0.262]	0.038 [0.201]	0.036 [0.229]	0.046 [0.121]	0.029 [0.332]	0.043 [0.146]
<b>N</b>	320	320	320	320	320	320
<b>Adjusted R Squared</b>	0.168	0.169	0.166	0.188	0.171	0.18

**Table B1: Baseline model – Regression results- Large Sample**

Table B1 exhibits the baseline regression results for the larger subsample of banks (total assets larger than US\$ 4 billion). The subsample is comprised of 98 banks and the adjusted r-squared is presented in the bottom of the table.

LARGE SAMPLE	CAR	Tier 1	Tier 2	Leverage	TCE	E Ratio
<b>Constant</b>	0.33 [0.413]	0.49 [0.253]	1.085 [0.016]	0.449 [0.276]	0.637 [0.107]	0.703 [0.079]
<b>Bank Capital</b>	1.33 [0.03]	1.7 [0.081]	-2.149 [0.06]	1.861 [0.002]	1.347 [0.039]	1.833 [0.003]
<b>Loans to assets</b>	-0.11 [0.541]	-0.052 [0.787]	-0.094 [0.661]	-0.194 [0.296]	-0.223 [0.223]	-0.297 [0.118]
<b>Deposits to assets</b>	-0.221 [0.369]	-0.424 [0.099]	-0.591 [0.054]	-0.383 [0.125]	-0.361 [0.145]	-0.42 [0.094]
<b>LLP to assets</b>	-5.706 [0.354]	-5.978 [0.349]	-9.722 [0.179]	0.156 [0.981]	-5.056 [0.420]	-0.002 [0.999]
<b>Cash to assets</b>	-0.259 [0.639]	-0.171 [0.766]	-0.134 [0.835]	-0.439 [0.442]	-0.304 [0.590]	-0.475 [0.42]
<b>Log(size)</b>	-0.131 [0.002]	-0.124 [0.008]	-0.132 [0.009]	-0.15 [0.001]	-0.141 [0.001]	-0.169 [0.000]
<b>Market beta</b>	-0.013 [0.912]	-0.094 [0.457]	-0.315 [0.026]	-0.016 [0.899]	-0.032 [0.798]	-0.047 [0.718]
<b>Return on equity</b>	0.018 [0.000]	0.017 [0.001]	0.008 [0.167]	0.018 [0.000]	0.018 [0.001]	0.019 [0.000]
<b>P/B Ratio</b>	-0.073 [0.185]	-0.07 [0.224]	0.007 [0.917]	-0.02 [0.729]	-0.072 [0.198]	-0.037 [0.511]
<b>N</b>	98	98	98	98	98	98
<b>Adjusted R Squared</b>	0.066	0.067	0.104	0.131	0.082	0.127

**Table B2:** Baseline model – Regression results- Mid Sample

Table B2 exhibits the baseline regression results for the mid subsample of banks (total assets in between US\$ 1.5 billion and US\$ 4 billion). The subsample is comprised of 104 banks and the adjusted r-squared is presented in the bottom of the table.

MID SAMPLE	CAR	Tier 1	Tier 2	Leverage	TCE	E Ratio
<b>Constant</b>	0.017 [0.979]	0.012 [0.985]	-0.08 [0.895]	-0.153 [0.8034]	-0.252 [0.263]	-0.136 [0.824]
<b>Bank Capital</b>	-0.644 [0.51]	-0.689 [0.449]	0.247 [0.862]	0.588 [0.491]	-0.338 [0.727]	0.689 [0.462]
<b>Loans to assets</b>	-0.405 [0.036]	-0.393 [0.034]	-0.36 [0.057]	-0.371 [0.049]	-0.352 [0.062]	-0.4 [0.045]
<b>Deposits to assets</b>	0.046 [0.868]	0.092 [0.734]	0.096 [0.737]	0.087 [0.752]	0.061 [0.825]	0.081 [0.767]
<b>LLP to assets</b>	-31.54 [0.000]	-32.78 [0.000]	-30.68 [0.000]	-29.861 [0.000]	-31.251 [0.000]	[-29.91] [0.000]
<b>Cash to assets</b>	3.574 [0.029]	3.826 [0.022]	3.484 [0.036]	3.164 [0.057]	3.381 [0.037]	3.119 [0.062]
<b>Log(size)</b>	-0.053 [0.764]	-0.07 [0.698]	-0.07 [0.7023]	-0.057 [0.752]	-0.06 [0.743]	-0.055 [0.759]
<b>Market beta</b>	0.127 [0.1375]	0.147 [0.097]	0.13 [0.153]	0.107 [0.221]	0.118 [0.135]	0.109 [0.212]
<b>Return on equity</b>	0.004 [0.258]	0.004 [0.254]	0.004 [0.231]	0.005 [0.189]	0.004 [0.245]	0.005 [0.183]
<b>P/B Ratio</b>	0.055 [0.271]	0.048 [0.334]	0.05 [0.326]	0.063 [0.222]	0.054 [0.287]	0.063 [0.221]
<b>N</b>	104	104	104	104	104	104
<b>Adjusted R Squared</b>	0.325	0.325	0.323	0.326	0.33	0.326



**Table B3: Baseline model – Regression results- Small Sample**

Table B3 exhibits the baseline regression results for the small subsample of banks (total assets below US\$ 1.5 billion). The subsample is comprised of 118 banks and the adjusted r-squared is presented in the bottom of the table.

SMALL SAMPLE	CAR	Tier 1	Tier 2	Leverage	TCE	E Ratio
<b>Constant</b>	0.097 [0.897]	0.101 [0.895]	0.221 [0.758]	0.117 [0.871]	0.142 [0.845]	0.191 [0.789]
<b>Bank Capital</b>	0.348 [0.474]	0.495 [0.517]	0.479 [0.521]	0.62 [0.326]	0.406 [0.509]	0.663 [0.378]
<b>Loans to assets</b>	-0.32 [0.126]	-0.313 [0.138]	-0.367 [0.053]	-0.377 [0.038]	-0.375 [0.04]	-0.435 [0.021]
<b>Deposits to assets</b>	-0.204 [0.422]	-0.233 [0.354]	-0.205 [0.421]	-0.186 [0.467]	-0.197 [0.445]	-0.193 [0.446]
<b>LLP to assets</b>	-8.898 [0.029]	-8.937 [0.029]	-9.101 [0.025]	-8.405 [0.041]	-8.739 [0.033]	-8.531 [0.039]
<b>Cash to assets</b>	3.817 [0.012]	3.893 [0.011]	3.748 [0.017]	3.52 [0.021]	3.688 [0.015]	3.477 [0.025]
<b>Log(size)</b>	-0.05 [0.822]	-0.049 [0.827]	-0.068 [0.758]	-0.051 [0.816]	-0.047 [0.831]	-0.057 [0.794]
<b>Market beta</b>	0.023 [0.81]	0.021 [0.827]	0.03 [0.742]	0.008 [0.933]	0.016 [0.869]	0.01 [0.914]
<b>Return on equity</b>	0.005 [0.285]	0.004 [0.34]	0.005 [0.271]	0.005 [0.243]	0.005 [0.273]	0.485 [0.253]
<b>P/B Ratio</b>	0.03 [0.596]	0.032 [0.571]	0.029 [0.607]	0.035 [0.534]	0.03 [0.595]	0.035 [0.536]
<b>N</b>	118	118	118	118	118	118
<b>Adjusted R Squared</b>	0.134	0.133	0.133	0.138	0.135	0.14